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Attorney Docket No. 16869P-014900US

"Express Mail" Label No. EL630576362US

Date of Deposit: September 25, 2000

ASSISTANT COMMISSIONER FOR PATENTS
BOX PATENT APPLICATION
Washington, D.C. 20231

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:
Transmitted herewith for filing under 37 CFR 1.53(b) is the
[X] patent application of
[ ] continuation patent application of
[ ] divisional patent application of
[ ] continuation-in-part patent application of

Inventor(s)/Applicant Identifier: **Ryota Mita and Akio Shinagawa**

For: **A Cellular Phone**

[ ] This application claims priority from each of the following Application Nos./filing dates:
_____,
the disclosure(s) of which is (are) incorporated by reference.

[ ] Please amend this application by adding the following before the first sentence: "This application is a [ ] continuation [ ] continuation-in-part of and claims the benefit of U.S. Application No. 60/_____, filed _____, the disclosure of which is incorporated by reference."

Enclosed are:
[X] 10 page(s) of specification
[X] 5 page(s) of claims
[X] 1 page of Abstract
[X] 7 sheet(s) of [X] formal [ ] informal drawing(s).
[X] An assignment of the invention to Hitachi, Ltd.
[X] A [X] signed [ ] unsigned Declaration & Power of Attorney
[X] Recordation Form Cover Sheet
[X] Preliminary Amendment

	(Col. 1)	(Col. 2)	SMALL ENTITY			OTHER THAN SMALL ENTITY	
FOR:	NO. FILED	NO. EXTRA	RATE	FEE	OR	RATE	FEE
BASIC FEE				$345.00	OR		$690.00
TOTAL CLAIMS	14 - 20	= *0	x $9.00 =		OR	x $18.00 =	$
INDEP. CLAIMS	5 - 3	= *2	x $39.00 =		OR	x $78.00 =	$156.00
[ ] MULTIPLE DEPENDENT CLAIM PRESENTED			+ $130.00 =		OR	+ $260.00 =	
			TOTAL		OR	TOTAL	$846.00

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2 extra copies of this sheet are enclosed.

Respectfully submitted,
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Assistant Commissioner for Patents
Washington, D.C. 20231

PATENT
Attorney Docket No. 16869P-014900US
Client Ref. No. 219901005US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Examiner: Unassigned
Ryota Mita et al.	Art Unit: Unassigned
Application No.: Unassigned	PRELIMINARY AMENDMENT
Filed: Herewith	
For: A Cellular Phone	

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-referenced application, please enter the following amendments and remarks.

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, line 7, after the title, insert

--CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims priority from Japanese Patent Application Reference No. 11-307987, filed October 29, 1999.--

Page 1, line 11, replace "consists" with --comprises--.

Page 1, line 12, delete "Description of Related Art".

Page 1, line 32, delete "Also,".

Page 1, line 32, replace "in" with --In--.

Page 2, line 2, after "unnatural", insert --sounding--.

Page 3, line 33, after "after", insert --it has been--.

Page 4, line 1, after "before", insert --it has been--.

Page 4, line 3, after "after", insert --it has been--.

Page 4, line 20, replace "communication" with --communications, such as--.

Page 4, line 20, delete "(".

Page 4, line 22, delete ")".

Page 5, line 4, replace "consists" with --comprises--.

Page 5, line 11, after "93" insert --, shown in Fig. 4, --.

Page 5, line 13, replace "are" with –is--.

Page 5, line 17, replace "on" with –comprising--.

Page 5, line 28, replace "The" with --In a specific embodiment, the--.

Page 6, line 26, replace "..." with --and so forth,--.

Page 9, line 32, replace "rage" with -- range--.

Page 10, line 3, after "after" insert --it has been--.

IN THE CLAIMS:

Please amend claims 1-5 and 7-14 as follows. For the Examiner's convenience, all pending claims are reproduced below. Those claims to which no amendment is requested appear in small print.

1. (Amended) A cellular phone comprising:

an antenna;

a high-frequency circuit unit connected to **[an]** the antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a control means for controlling said high-frequency circuit unit and said audio circuit unit;

a memory means connected to the control means;

a control unit connected to said control means;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generating means for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generating means is stored in said memory means; and wherein **[so that]** said control means controls said signal generating means based on said signal data; and

said signal data stored in said memory means are of **[the]** a frequency in a range between said first frequency and said second frequency, and wherein the audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency is supplied to said speaker by said signal generating means.

2. (Amended) A cellular phone as claimed in claim 1,

wherein said signal data includes interval data, **[and]** scale data, and **[as well as]** tone data.

3. (Amended) A cellular phone as claimed in claim 1,

wherein said memory means stores a plurality of **[pieces of]** signal data having first tone data in a specified order, and stores a plurality of **[pieces of]** signal data having second tone data in a specified order; and

[said control means controls] said signal generating means **[in such a manner that]** generates an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data **[are generated]** with predetermined timing.

4. (Amended) A cellular phone as claimed in claim 3,

wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in intervals and scales with each other **[in terms of their intervals and scales]**.

5. (Amended) A cellular phone comprising:

an antenna;

a high-frequency circuit unit connected to **[an]** the antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a control means for controlling said high-frequency circuit unit and said audio circuit unit;

a memory means connected to the control means;

a control unit connected to said control means;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generating means for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generating means is stored in said memory means; and wherein **[so that]** said control means controls said signal generating means based on said signal data;

said signal data includes interval data, **[and]** scale data, and **[as well as]** tone data; and wherein said signal data **[is divided into]** comprises a plurality of parts corresponding to said **[according to each piece of]** tone data, whereby in a part having a wide range of frequency distribution, said signal data includes a corresponding audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency, and is stored in said memory means; and whereby

in a part having a narrow range of frequency distribution, said signal data is stored in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

the audio signal stored in said memory means is supplied to said speaker.

6. A cellular phone as claimed in claim 5,

wherein said control means causes each of the audio signals of said plurality of parts to be supplied to said speaker with predetermined timing.

7. (Amended) A cellular phone as claimed in claim 6,

wherein the audio signals of said plurality of parts form a chord relation in intervals and scales with one another **[in terms of their intervals and scales]** when the audio signals of said plurality of parts are supplied to said speaker with predetermined timing.

8. (Amended) A melody sound reproducing unit comprising:

a speaker for providing **[specified]** output in a range between a first frequency and a second frequency;

a signal generating means for supplying an audio signal to the speaker;

a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and

a control means for controlling said signal generating means based on said signal data;

wherein said signal data is stored in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

the audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency is supplied to said speaker.

9. (Amended) A melody sound reproducing unit as claimed in claim 8,

wherein said signal data includes interval data, **[and]** scale data, and **[as well as]** tone data;

said memory means stores a plurality of **[pieces of]** signal data having first tone data in a specified order and stores a plurality of **[pieces of]** signal data having second tone data in a specified order; and

[said control means controls] said signal generating means **[in such a manner that]** generates an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data **[are generated]** with predetermined timing.

10. (Amended) A melody sound reproducing unit as claimed in claim 9,

wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in intervals and scales with each other **[in terms of their intervals and scales]**.

11. (Amended) A melody sound reproducing method for a melody sound reproducing unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data; said method comprising:

[a step in which] storing said signal data **[is stored]** in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

[a step in which the] supplying an audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency **[is supplied]** to said speaker.

12. (Amended) A melody sound reproducing method as claimed in claim 11,

wherein said signal data includes interval data, **[and]** scale data, and **[as well as]** tone data.

13. (Amended) A melody sound reproducing **[method for a melody sound reproducing]** unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data;

wherein said memory means stores a plurality of **[pieces of]** portions of signal data having first tone data in specified order, said signal data including a corresponding audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency, and stores a plurality of **[pieces of]** portions of signal data having second tone data in specified order, said signal data including a corresponding audio signal **[whose]** having a frequency **[is]** in a range between said first frequency and said second frequency; and

wherein said control means controls said signal generating means **[in such a manner that]** to generate the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data **[are generated]** substantially simultaneously, whereby a sound corresponding to the signal data which has said first tone data and includes a corresponding audio signal **[whose]** having a frequency is in a range between said first frequency and said second frequency and a sound corresponding to the signal data which has said second tone data and includes a corresponding audio signal **[whose]** having a frequency is in a range between said first frequency and said second frequency are produced from said speaker with a predetermined timing.

14. (Amended) A melody sound reproducing **[method]** unit as claimed in claim 13,

wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in at least one of intervals and scales with each other **[in terms of their intervals and scales]**.

15. A method for reproducing a melody, said method comprising:

determining a range between a first frequency and a second frequency;

determining a frequency of an audio signal corresponding to a signal data;

storing said signal data in a memory in specified order when a frequency of the corresponding audio signal is in said range between said first frequency and said second frequency; and

supplying an audio signal having a frequency in said range between said first frequency and said second frequency as audio output.

16. A method for reproducing a melody as claimed in claim 15, further comprising:

generating with predetermined timing said audio signal, said audio signal comprising an audio signal corresponding to a first tone data of said signal data, and an audio signal corresponding to a second tone data of said signal data; and wherein, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation in intervals and scales.

17. A cellular phone comprising:

an antenna;

a high-frequency circuit unit connected to the antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a controller for controlling said high-frequency circuit unit and said audio circuit unit;

a memory connected to the controller;

a control unit connected to the controller;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generator for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generator is stored in said memory; and wherein said controller controls said signal generator based on said signal data; and

said signal data stored in said memory is of a frequency in a range between said first frequency and said second frequency, and wherein the audio signal having a frequency in a range between said first frequency and said second frequency is supplied to said speaker.

REMARKS

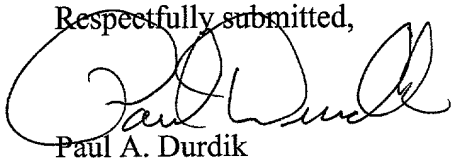
Claims 1-17 are pending in this application. Claims 1-5 and 7-14 have been voluntarily amended to more clearly set forth the claimed invention. New claims 15-17 have been added. Applicant makes minor typographical corrections to the specification. Applicant avers that no new matter has been introduced.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at .

Respectfully submitted,



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PATENT APPLICATION

A Cellular Phone

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PATENT
Attorney Docket No. 16869P-014900
Client Ref. No. 219901005US1

A Cellular Phone

BACKGROUND OF THE INVENTION

The present invention relates to a cellular phone that signals receipt of a call by using a melody, and particularly to a cellular phone suitable to generate receiving sound that consists of a plurality of tones.

Description of Related Art

A conventional receiving sound generator of a cellular phone supplies a signal corresponding to a melody stored in a memory to a speaker as it is.

Since smaller size and lighter weight is required of a cellular phone, a speaker for producing receiving sound used in the cellular phone is of small size. Generally, a speaker with a diameter of about 20 mm is used. In such a small-sized speaker, a frequency range is limited to that between a low frequency of about 400 Hz and a high frequency of about 8 kHz. In this frequency range, a range of about 600 Hz to about 5 kHz allows a sufficient level of sound pressure to be generated. Conventionally, when a signal corresponding to a receiving melody is supplied to such a speaker, the inputted signal is not outputted as sound in a range lower than 400 Hz or in a range higher than 8 kHz, and yet only electric power is consumed. On the other hand, the power allowed to be inputted to a speaker includes power consumed in a frequency range where a signal is not outputted as sound. Therefore, if an input signal includes a signal outside of a frequency range of 400 Hz to 8 kHz, the level of the input signal in the frequency range of 400 Hz to 8 kHz needs to be lowered in order to control the input power to within an allowable value. The level of the input signal needs to be controlled to a low level especially when a melody is to be accompanied by a chord, because the chord may include a signal for high-pitched sound or low-pitched sound that falls outside of the frequency range of 400 Hz to 8 kHz. Thus, it has been difficult to increase the volume of receiving sound. Also, in order to solve this problem, supplying an input signal through a bandpass filter has been considered. However, the method of supplying an input signal through a bandpass filter has a problem in that if a melody includes a note having a

frequency outside of the frequency range of 400 Hz to 8 kHz, the note is omitted, thereby resulting in an unnatural melody. If a melody is accompanied by a chord and one of the chord notes falls outside of the frequency range of 400 Hz to 8 kHz, the chord is not formed, and therefore the sound may be perceived as strange when the melody is heard.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

In order to solve the problem described above, there is provided a melody sound reproducing unit according to the present invention, comprising: a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data; wherein the signal data is stored in the memory means when the frequency of the corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

In addition, in order to solve the problem described above, there is provided a melody sound reproducing method for a melody sound reproducing unit according to the present invention, the reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data; wherein the signal data is stored in the memory means when the frequency of the corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

In a preferred embodiment, the memory means stores a plurality of pieces of signal data having first tone data in specified order and stores a plurality of pieces of signal data having second tone data in specified order, and the control means controls the

signal generating means in such a manner that an audio signal corresponding to the signal data having the first tone data and an audio signal corresponding to the signal data having the second tone data are generated simultaneously.

In another preferred embodiment, when an audio signal corresponding to the signal data having the first tone data and an audio signal corresponding to the signal data having the second tone data are generated simultaneously, the audio signal corresponding to the signal data having the first tone data and the audio signal corresponding to the signal data having the second tone data form a chord relation with each other in terms of their intervals and scales.

According to the present invention, it is possible to provide a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the circuit configuration of a cellular phone according to a first embodiment of the present invention;

Fig. 2 is an exploded perspective view of the structure of a cellular phone according to a first embodiment of the present invention;

Fig. 3 is a perspective view of the circuit board of a cellular phone according to a first embodiment of the present invention;

Fig. 4 is a perspective view of the outward appearance of a cellular phone according to a first embodiment of the present invention;

Fig. 5 is a graph showing the frequency characteristics of the speaker of a cellular phone according to a first embodiment of the present invention.

Fig. 6 shows the relation between the chords and the frequencies of note data used for a cellular phone according to a first embodiment of the present invention;

Fig. 7 is a flowchart showing a frequency shift of a cellular phone according to a first embodiment of the present invention;

Fig. 8 is a flowchart showing a frequency shift of a cellular phone according to a second embodiment of the present invention; and

Figs. 9(a) and 9(b) are charts showing the frequency characteristics of the speaker of a cellular phone according to a second embodiment of the present invention as well as a frequency distribution of note data before and after stepped up, Fig. 9(a) being a

characteristic chart showing the frequency distribution of the note data before stepped up and Fig. 9(b) being a characteristic chart showing the frequency distribution of the note data after stepped up.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

A first embodiment of the present invention will be described with reference to Figs. 1 to 7.

As shown in Fig. 1, a cellular phone according to the first embodiment of the present invention is provided with an antenna 10, a high-frequency circuit unit 20 connected with the antenna 10, an audio circuit unit 30 connected with the high-frequency circuit unit 20, and a speaker 40, a receiver 46, and a microphone 48 (hereinafter referred to as a mike) connected with the audio circuit unit 30. The audio circuit unit 30 includes an FM sound source 35 that generates receiving sound. The cellular phone according to the first embodiment is further provided with a CPU 60 as a control means for controlling various functions. The CPU 60 controls the high-frequency circuit unit 20 and the audio circuit unit 30 according to a control program stored in a memory 80 that is connected to the CPU 60. The CPU 60 is connected with a control unit 70 and a display unit 50. The CPU 60 controls the high-frequency circuit unit 20 and the audio circuit unit 30 also according to input from the control unit 70 based on a control program, and displays on the display unit 50 information necessary for communication (the state of electric waves, the telephone number of the person at the other end of a phone call, e-mail addresses, and e-mail data to be received or transmitted, and the like) or information necessary for the user of the cellular phone.

As shown in Figs. 2 and 3, the high-frequency circuit unit 20, the audio circuit unit 30, the CPU 60, the memory 80, the control unit 70, the display unit 50, the speaker 40, the receiver 46, and the mike 48 are mounted on a circuit board 65. For the convenience of description, suppose that the side where the control unit 70 is mounted is a front side, and the opposite side is a rear side. Then the control unit 70, the display unit 50, the receiver 46, and the mike 48 are mounted on the front side of the circuit board 65, while the high-frequency circuit unit 20, the audio circuit unit 30, the CPU 60, the memory 80, and the speaker 40 are mounted on the rear side of the circuit board 65. The high-frequency circuit unit 20 is covered with a shield 20a, and the speaker 40 is placed on the surface of the shield 20a with an elastic member situated intermediate between the

speaker 40 and the surface of the shield 20a. On a side of the circuit board 65 where the mike 48 is placed, there is provided a connector 66 for connection with a charging adapter or for data communication with a personal computer (hereinafter referred to as PC) or the like. A casing 90 consists of a case 92 and a cover 94. The case 92 covers the rear side of the circuit board 65, while the cover 94 covers the front side of the circuit board 65. The antenna 10, which is capable of telescoping, is placed on a side of the case 92 where the speaker 40 is mounted, and connected to the high-frequency circuit unit 20 via a contact piece 10a provided on the rear side of the circuit board 65 in an entirely housed state or in an entirely extended state. A cover 66a that can open and close is provided on a side of the case 92 that is opposite to the antenna 10 side so as to cover an opening of the connector 66. A battery housing unit 92a for housing a rechargeable battery 93 is formed on the external surface of the rear side of the case 92.

As shown in Fig. 4, there are provided on the cover 94 the receiver 46, the display unit 50, the control unit 70, and the mike 48 along a direction from the antenna 10 side to the cover 66a side.

The cellular phone according to the first embodiment has a function of reproducing a melody on receiving a call, instead of a bell sound. Data on the melody is stored in a melody memory unit 85 in the memory 80. The melody is reproduced mainly from four types of melody data, that is, : (1) fixed melody data stored in the melody memory unit 85 when the cellular phone is manufactured; (2) melody data downloaded via the Internet after the user purchased the cellular phone, and stored in the melody memory unit 85; (3) melody data transferred via e-mail after the user purchased the cellular phone, and stored in the melody memory unit 85; and (4) melody data created by the user by using a terminal such as a PC after the user purchased the cellular phone, and stored in the melody memory unit 85.

The melody is formed by inputting note data including tone data for imitating the tone of a musical instrument, as well as data on intervals, scales, and sound length. The tone data provides 128 types of basic tones including those of a piano, a guitar, a flute, and a synthesizer. If necessary, the variety of sound expression can be increased by adding other tone data.

Fig. 5 is a graph showing the frequency characteristics of the speaker of the first embodiment. The speaker 40 is capable of outputting an input signal in the form of sound waves in a frequency range between fc1, the lowest frequency, and fc2, the

highest frequency. According to the first embodiment, fc1 is 400 Hz, and fc2 is 8 kHz. The speaker 40 has substantially flat output characteristics particularly in a frequency range of f1 to f 2, and the characteristic peak is set at a frequency fQ, which is used to reproduce the bell sound of the phone. According to the first embodiment, f1 is 600 Hz, and f2 is 5 kHz. Also, the frequency fQ is 2 kHz to 3 kHz, and the peak is set in such a way that a standard bell sound (ON for one second at a frequency of 2 kHz to 3 kHz and OFF for two seconds) can be produced at a high sound volume level of about 95 dB.

The range between 600 Hz to 5 kHz provides excellent conversion efficiency, and therefore provides a high level of sound pressure even with a little electric power. In the first embodiment, note data is set in such a way that a melody can be formed within a range between a first frequency fc1 of 400 Hz and a second frequency fc2 of 8 kHz. As shown in Fig. 6, of the scale chords, G#3 (415.3 Hz) exceeds the frequency of 400 Hz; however, a frequency equal to a scale chord A3 (440.0 Hz) or higher than the scale chord A3 is used in the first embodiment to prevent power consumption at the frequency fc1 or lower.

In order to form a melody, tone data and note data are stored in specified order in the melody memory unit 85, which serves as a memory means. In the first embodiment, a melody is reproduced with an accompanying chord. For the tone of the chord, the tone of a musical instrument different from that playing the melody is used. In this case, tone data (first tone data) corresponding to the musical instrument that plays the melody and note data to be played with the tone data are stored in specified order in the melody memory unit 85. Also, tone data (second tone data) corresponding to the musical instrument that plays the chord notes and note data to be played with the tone data are stored in specified order in the melody memory unit 85. Depending on the musical number, a plurality of pieces of note data to be played with third tone data, a plurality of pieces of note data to be played with fourth tone data, ... are also stored in specified order in the melody memory unit 85. The CPU 60 serving as a control means controls the FM sound source 35 in such a manner that the FM sound source 35 serving as a signal generating means generates an audio signal corresponding to the melody and an audio signal corresponding to the chord notes with predetermined timing. The timing is set in such a manner as to make the person hearing the melody perceive the chord. More specifically, the timing is set in such a manner as to make the audio signals simultaneous,

or make a time difference between the audio signals controlled to such a degree that the audio signals are perceived as simultaneous.

A sound imitating an acoustic bass and other musical instruments that produce low-pitched sound, for example, is used in some cases as the tone of the chord. In this case, the scale frequency of the inputted note data can be lower than fc1, depending on the melody. In a case where fixed melody data is stored in the melody memory unit 85 when the cellular phone is manufactured, or in a case where melody data is created by the user by using a terminal such as a PC after the user purchased the cellular phone, and stored in the melody memory unit 85, a melody is formed by selecting in advance a chord whose frequency is 400 Hz or more even in a low range as note data to be stored. In a case where melody data is downloaded via the Internet after the user purchased the cellular phone, and stored in the melody memory unit 85, or in a case where melody data is transferred via e-mail after the user purchased the cellular phone, and stored in the melody memory unit 85, scale correction software is stored in the memory 80 so that the CPU 60 shifts the scale of the note data and thereby makes the frequency become 400 Hz or more, as shown in Fig. 7. Specifically, the CPU 60 reads note data (S101) to determine whether the note data includes a note whose scale is lower than A3 (S102). If the answer is Yes, the CPU 60 steps up the whole note data to be reproduced with the tone of the selected musical instrument by a half step (frequency shift) (S103), and determines again whether the note data includes a note whose scale is lower than A3 at the step S102. If the answer is Yes, the CPU 60 repeats the steps S103 and S102 of stepping up the note data by a half step and determining again whether the note data includes a note whose scale is lower than A3. If the answer is No, the CPU 60 proceeds to setting operation (S104). The set note data is stored in a predetermined area in the melody memory unit 85. Thus, all of the note data to be reproduced falls within a range of 400 Hz to 8 kHz. Therefore, electric power consumed by the speaker 40 is not wasted, and the level of the input signal can be increased within a range of allowable input power values of the speaker 40. It is not necessary to lower the level of the input signal even when the melody is to be reproduced with a chord because the inputted note data falls within a frequency range of 400 Hz to 8 kHz.

According to the first embodiment, especially in the case of a melody with a few low-pitched parts, most of the note data falls within a frequency range of 600 Hz to 5 kHz even when the melody is accompanied by a chord. Therefore, the electric power of

the input signal can be efficiently converted into sound energy, thereby making it possible to reproduce the melody at a high sound volume level. In addition, even when the low-pitched parts are accompanied by a chord, the note data falls within a frequency range of 400 Hz to 8 kHz. Therefore, all of the chord notes can be reproduced, thereby producing agreeable, natural sound and allowing the user to hear high-quality receiving sound.

A second embodiment of the present invention will be described with reference to Figs. 8 and 9. In the second embodiment, provided note data includes a plurality of musical parts. Therefore, as shown in Fig. 8, a part is first selected (S201), and then note data included in the selected part is read (S202) in order to perform energy analysis, that is, analyze frequency components of the note data (S203). Then, whether the note data is to be stepped up or not is determined, depending on the result of the analysis. In the second embodiment, the distribution of frequency components of the note data is analyzed after the note data is read, as shown in Fig. 8. For example, analysis is performed by determining the distribution of notes at each scale. As shown in Fig. 5, the speaker 40 is capable of outputting an input signal in the form of sound waves in a frequency range between fc1, the lowest frequency, and fc2, the highest frequency, where fc1 is 400 Hz, and fc2 is 8 kHz, for example. Based on the result of the analysis of frequency components, the proportion of the whole note data occupied by notes having a frequency fc1 or lower is calculated to determine whether the proportion is more than 60% (S204). If the proportion of the whole note data occupied by notes having a frequency fc1 or lower exceeds 60%, most of the sound will not be reproduced. Therefore, the note data is stepped up when the proportion of the note data occupied by notes having a frequency fc1 or lower is more than 60% (S205). As in the case of the first embodiment, the whole note data included in the selected part is stepped up by a half step, and the steps S205 and S204 are repeated until the proportion of the note data occupied by notes having a frequency fc1 or lower becomes less than 60%. If the proportion of the note data occupied by notes having a frequency fc1 or lower becomes less than 60%, scale setting operation is performed (S206). Then whether there is another part or not is determined (S207). If there is another part, the processing returns to the step S201. If there is no other part, the processing ends (S208). Accompanying parts in a low range often fall outside of the low range that can be reproduced by the speaker especially when the melody signaling receipt of a call includes a chord. This tendency becomes more obvious as the number of accompanying parts is increased. In the second

embodiment, when there are a large number of accompanying parts, distribution of frequency components of note data is analyzed for each of the parts, and whether the note data is to be stepped up or not is determined for each of the parts. For example, if there are three accompanying parts other than the melody part, and one of the three parts in a low range, such as an acoustic bass, falls outside of the low range of the speaker, as shown in Fig. 9(a), only that part is stepped up until it reaches a state shown in Fig. 9(b) so that all of the parts exist within the range that can be reproduced by the speaker. An audio signal for each of the parts is controlled by the control means in such a way that the audio signal is reproduced with predetermined timing. The timing is set in such a manner as to make the person hearing the melody perceive the chord. More specifically, the timing is set in such a manner as to make the audio signals simultaneous, or make a time difference between the audio signals controlled to such a degree that the audio signals are perceived as simultaneous. This makes it possible for the user of the cellular phone to enjoy a melody with a chord. It is to be noted that if distribution of frequency components of note data falls way outside of the low range of the speaker, the note data may be stepped up not by a half step but by a whole step or more.

The possibility that an accompanying part in a low range includes sound at a frequency of 400 Hz or lower at a rate of more than 60% is increased especially when a melody has three accompanying parts, which is called a four-chorded melody, or a melody has more than three accompanying parts. In this case, the resulting sound may be monotonous if all of the parts are stepped up to more than 400 Hz. In such a case, a melody can be reproduced in a wide range by using a speaker capable of reproducing a wider frequency range or, for example, a speaker capable of reproducing a low range down to 200 Hz, and determining for each part whether the note data is to be stepped up or not by using 200 Hz as a criterion for judgment. Specifically, it is possible to reproduce sound down to a scale chord A2, and therefore it is possible to widen the reproducible range by one octave as compared with the case where 400 Hz is used as a criterion.

This makes it possible to reproduce most of the sound of accompanying parts such as an acoustic bass, whose sound is distributed in a low range at a rate of 70% to 80%, by stepping up the note data. As for an accompanying part played by a musical instrument producing a wide rage of sound, the proportion of the note distribution of the accompanying part that falls outside of the low range of the speaker is small, and

therefore the note data is not stepped up. Thus, it is possible to prevent the sound of the accompanying part on the high range side from falling outside of the reproducible range of the speaker after stepped up. Therefore, in the second embodiment, most of the sound of each part can be contained within the reproducible range of the speaker even when the number of chord notes is increased.

The preceding has been a description of the preferred embodiment of the invention. It will be appreciated that deviations and modifications can be made without departing from the scope of the invention, which is defined by the appended claims.

What is claimed is:

1. A cellular phone comprising:

a high-frequency circuit unit connected to an antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a control means for controlling said high-frequency circuit unit and said audio circuit unit;

a memory means connected to the control means;

a control unit connected to said control means;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generating means for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generating means is stored in said memory means so that said control means controls said signal generating means based on said signal data; and

said signal data stored in said memory means are of the frequency in a range between said first frequency and said second frequency, and the audio signal whose frequency is in a range between said first frequency and said second frequency is supplied to said speaker.

2. A cellular phone as claimed in claim 1,

wherein said signal data includes interval and scale data as well as tone data.

3. A cellular phone as claimed in claim 1,

wherein said memory means stores a plurality of pieces of signal data having first tone data in specified order and stores a plurality of pieces of signal data having second tone data in specified order; and

said control means controls said signal generating means in such a manner that an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing.

4. A cellular phone as claimed in claim 3,

wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation with each other in terms of their intervals and scales.

5. A cellular phone comprising:

a high-frequency circuit unit connected to an antenna;

an audio circuit unit connected to the high-frequency circuit unit;

a control means for controlling said high-frequency circuit unit and said audio circuit unit;

a memory means connected to the control means;

a control unit connected to said control means;

a microphone and a receiver connected to said audio circuit unit;

a speaker for providing specified output in a range between a first frequency and a second frequency; and

a signal generating means for supplying an audio signal to the speaker;

wherein signal data corresponding to an audio signal to be generated by said signal generating means is stored in said memory means so that said control means controls said signal generating means based on said signal data;

said signal data includes interval and scale data as well as tone data and is divided into a plurality of parts according to each piece of tone data, whereby in a part having a wide range of frequency distribution, said signal data includes a corresponding audio signal whose frequency is in a range between said first frequency and said second frequency, and is stored in said memory means;

in a part having a narrow range of frequency distribution, said signal data is stored in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

the audio signal stored in said memory means is supplied to said speaker.

6. A cellular phone as claimed in claim 5,

wherein said control means causes each of the audio signals of said plurality of parts to be supplied to said speaker with predetermined timing.

7. A cellular phone as claimed in claim 6,

wherein the audio signals of said plurality of parts form a chord relation with one another in terms of their intervals and scales when the audio signals of said plurality of parts are supplied to said speaker with predetermined timing.

8. A melody sound reproducing unit comprising:

a speaker for providing specified output in a range between a first frequency and a second frequency;

a signal generating means for supplying an audio signal to the speaker;

a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and

a control means for controlling said signal generating means based on said signal data;

wherein said signal data is stored in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

the audio signal whose frequency is in a range between said first frequency and said second frequency is supplied to said speaker.

9. A melody sound reproducing unit as claimed in claim 8,

wherein said signal data includes interval and scale data as well as tone data;

said memory means stores a plurality of pieces of signal data having first tone data in specified order and stores a plurality of pieces of signal data having second tone data in specified order; and

said control means controls said signal generating means in such a manner that an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing.

10. A melody sound reproducing unit as claimed in claim 9, wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal corresponding to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation with each other in terms of their intervals and scales.

11. A melody sound reproducing method for a melody sound reproducing unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data; said method comprising:

a step in which said signal data is stored in said memory means when the frequency of the corresponding audio signal is in a range between said first frequency and said second frequency; and

a step in which the audio signal whose frequency is in a range between said first frequency and said second frequency is supplied to said speaker.

12. A melody sound reproducing method as claimed in claim 11, wherein said signal data includes interval and scale data as well as tone data.

13. A melody sound reproducing method for a melody sound reproducing unit, said reproducing unit including a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling said signal generating means based on said signal data;

wherein said memory means stores a plurality of pieces of signal data having first tone data in specified order, said signal data including a corresponding audio signal whose frequency is in a range between said first frequency and said second

frequency, and stores a plurality of pieces of signal data having second tone data in specified order, said signal data including a corresponding audio signal whose frequency is in a range between said first frequency and said second frequency; and

said control means controls said signal generating means in such a manner that the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data are generated simultaneously, whereby a sound corresponding to the signal data which has said first tone data and includes a corresponding audio signal whose frequency is in a range between said first frequency and said second frequency and a sound corresponding to the signal data which has said second tone data and includes a corresponding audio signal whose frequency is in a range between said first frequency and said second frequency are produced from said speaker with predetermined timing.

14. A melody sound reproducing method as claimed in claim 13, wherein when an audio signal corresponding to the signal data having said first tone data and an audio signal to the signal data having said second tone data are generated with predetermined timing, the audio signal corresponding to the signal data having said first tone data and the audio signal corresponding to the signal data having said second tone data form a chord relation with each other in terms of their intervals and scales.

A Cellular Phone

ABSTRACT OF THE DISCLOSURE

The present invention provides a cellular phone that makes it possible to reproduce a melody for signaling receipt of a call without impairing musical data, and to increase the volume of receiving sound.

A cellular phone according to the present invention is provided with a melody sound reproducing unit comprising: a speaker for providing specified output in a range between a first frequency and a second frequency; a signal generating means for supplying an audio signal to the speaker; a memory means for storing signal data corresponding to an audio signal to be generated by the signal generating means; and a control means for controlling the signal generating means based on the signal data, wherein the signal data is stored in the memory means when the frequency of the corresponding audio signal is in a range between the first frequency and the second frequency, and the audio signal whose frequency is in a range between the first frequency and the second frequency is supplied to the speaker.

FIG.1

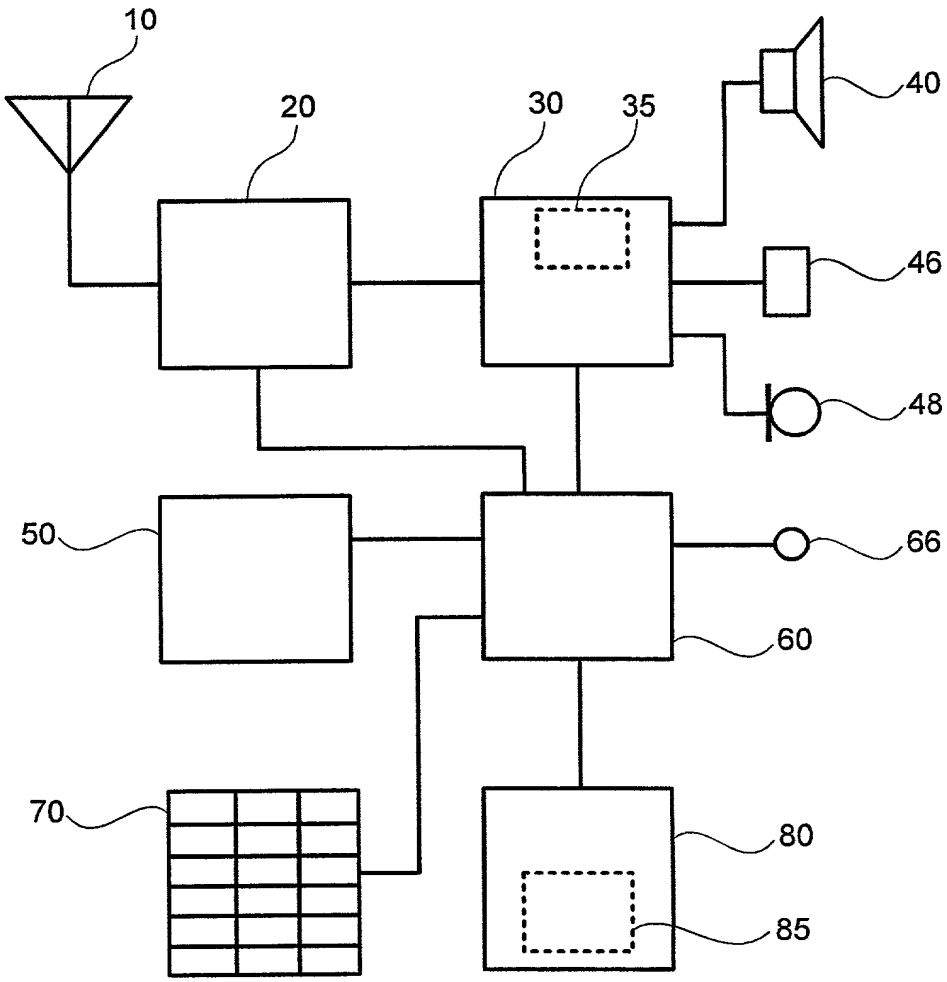


FIG.2

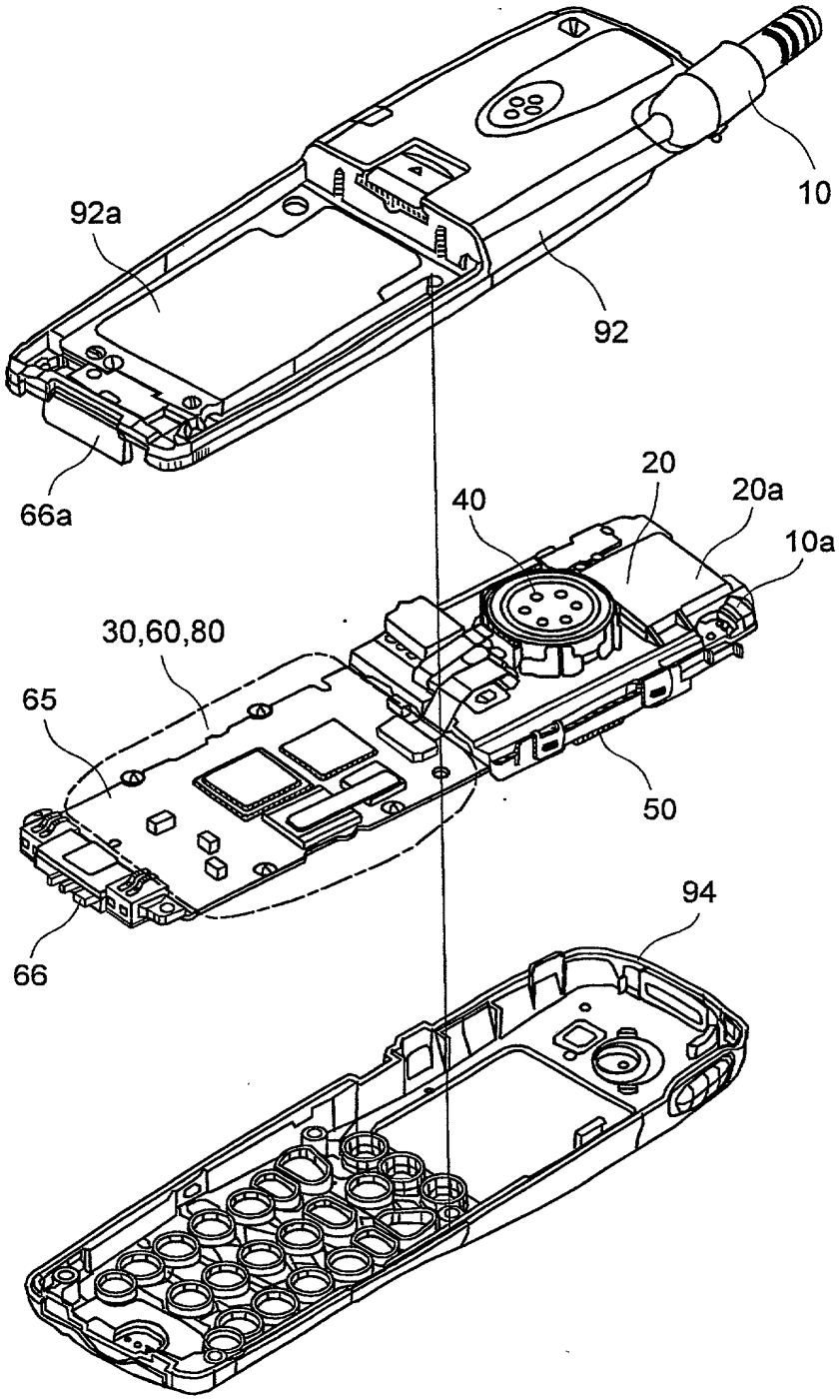


FIG.3

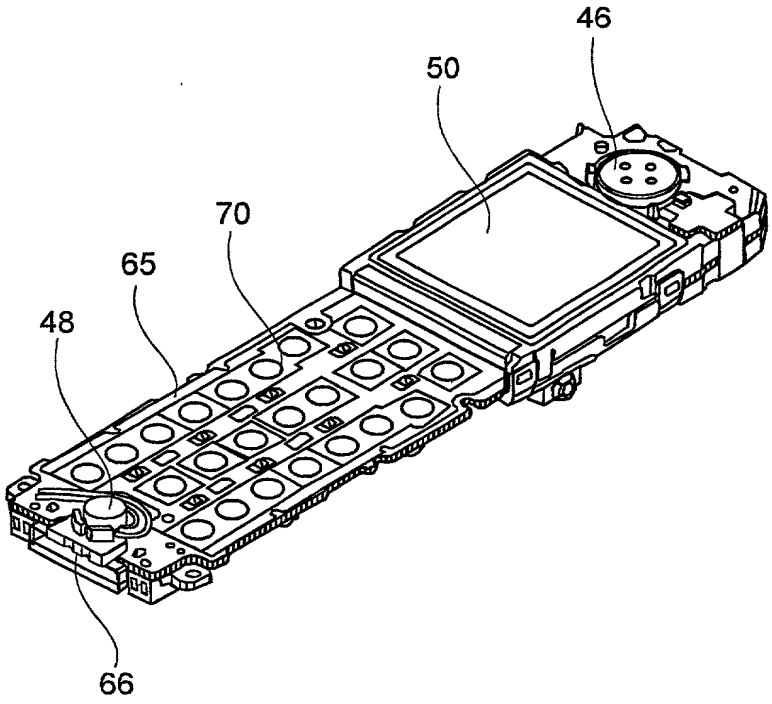


FIG.4

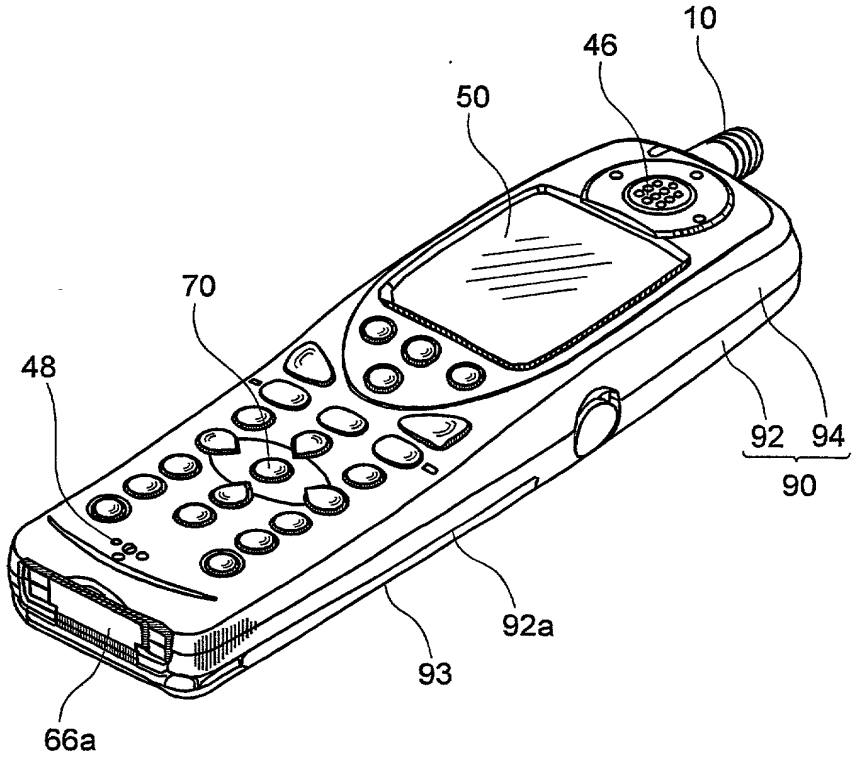

10
46
50
70
48
92
94
90
92a
93
66a

FIG.5

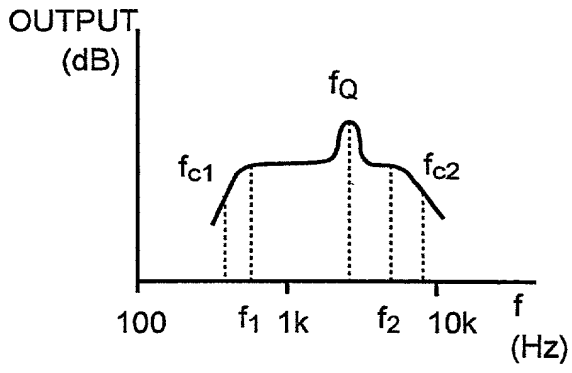

OUTPUT
(dB)
fQ
fc1
fc2
100
f1
1k
f2
10k
f
(Hz)

FIG.6

SCALE	FREQUENCY (HZ)	SCALE	FREQUENCY (HZ)	SCALE	FREQUENCY (HZ)
C#2	138.6	C#3	277.2	C#4	554.4
D2	146.8	D3	293.7	D4	587.3
D#2	155.6	D#3	311.1	D#4	622.3
E2	164.8	E3	329.6	E4	659.3
F2	174.6	F3	349.2	F4	698.5
F#2	185.0	F#3	370.0	F#4	740.0
G2	196.0	G3	392.0	G4	784.0
G#2	207.7	G#3	415.3	G#4	830.6
A2	220.0	A3	440.0	A4	880.0
A#2	233.1	A#3	466.2	A#4	932.3
B2	247.0	B3	493.3	B4	987.8
C3	261.6	C4	523.3	C5	1047

FIG.7

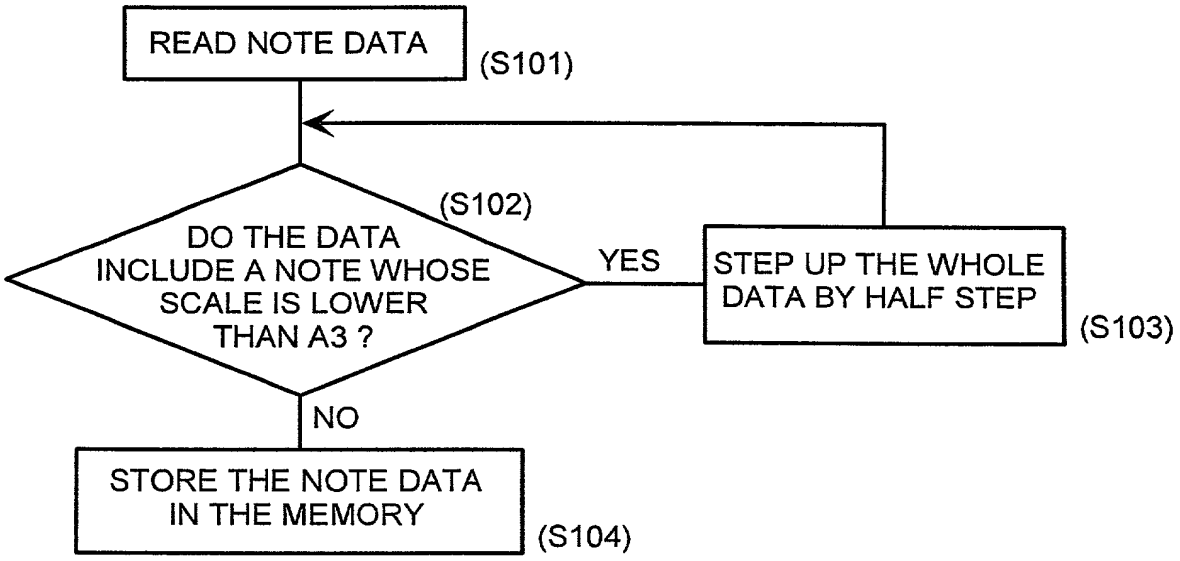


FIG.8

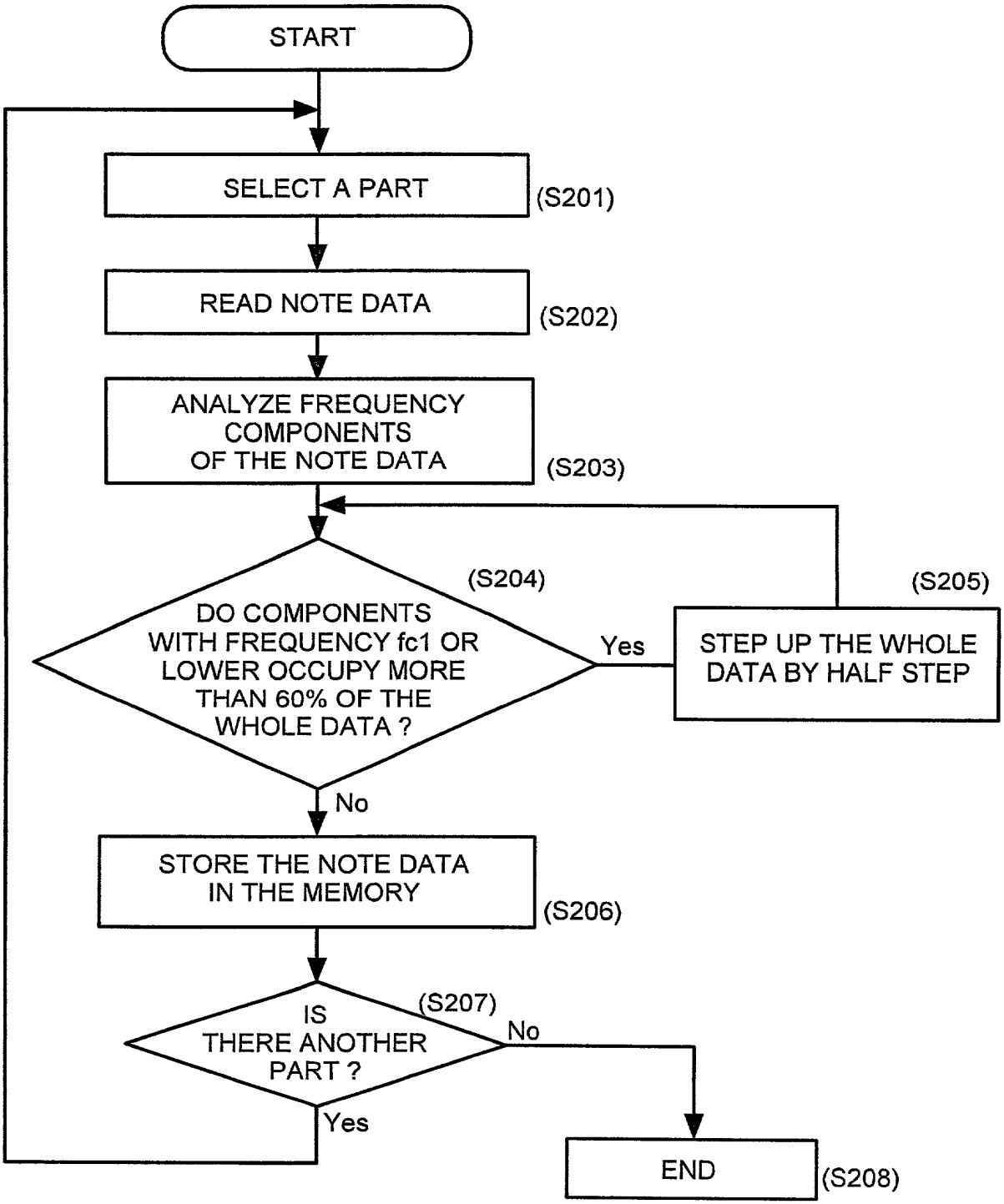
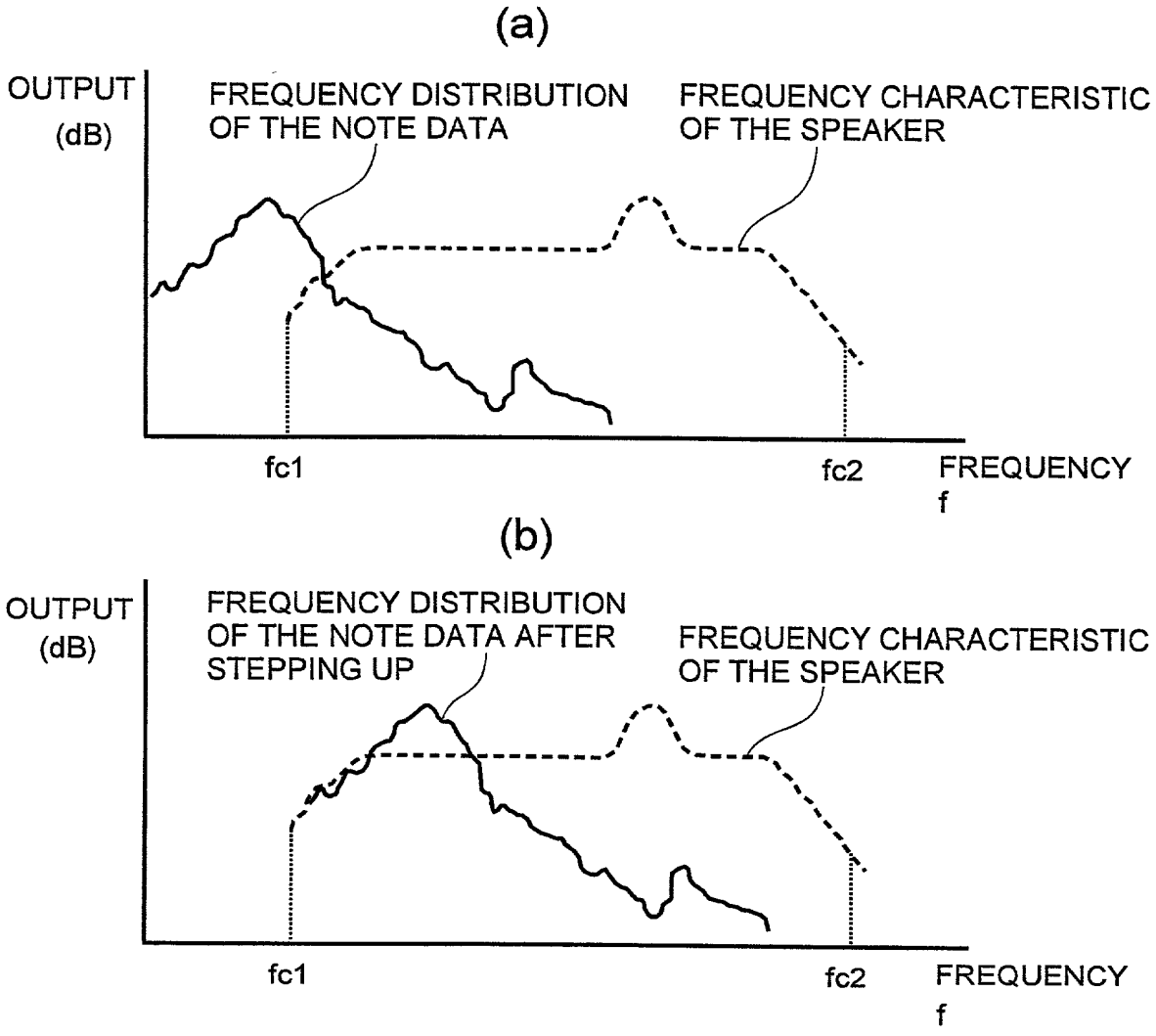

START
SELECT A PART
(S201)
READ NOTE DATA
(S202)
ANALYZE FREQUENCY COMPONENTS OF THE NOTE DATA
(S203)
(S204)
DO COMPONENTS WITH FREQUENCY fc1 OR LOWER OCCUPY MORE THAN 60% OF THE WHOLE DATA ?
Yes
(S205)
STEP UP THE WHOLE DATA BY HALF STEP
No
STORE THE NOTE DATA IN THE MEMORY
(S206)
(S207)
IS THERE ANOTHER PART ?
No
Yes
END
(S208)

FIG.9


(a)
OUTPUT
(dB)
FREQUENCY DISTRIBUTION
OF THE NOTE DATA
FREQUENCY CHARACTERISTIC
OF THE SPEAKER
fc1
fc2
FREQUENCY
f
(b)
OUTPUT
(dB)
FREQUENCY DISTRIBUTION
OF THE NOTE DATA AFTER
STEPPING UP
FREQUENCY CHARACTERISTIC
OF THE SPEAKER
fc1
fc2
FREQUENCY
f

PTO/SB/106(8-96)
Approved for use through 9/30/98. OMB 0651-0032
Patent and Trademark Office; U.S. DEPARTMETNT OF COMMERCE

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A CELLULAR PHONE

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

The specification of which is attached hereto unless the following box is checked:

☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、
(該当する場合) _____に訂正されました。

☐ was filed on
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第３７編第１条５６項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

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Patent and Trademark Office; U.S. DEPARTMETNT OF COMMERCE

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第３５編１１９条 (a) - (d) 項又は３６５条 (b) 項に基き下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約３６５ (a) 項に基ずく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示している。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Not Claimed 優先権主張なし
11-307987	Japan	29/October/1999	☐
			☐

私は、第３５編米国法典１１９条 (e) 項に基いて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第３５編１２０条に基いて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約３６５条 (c) に基ずく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第３５編１１２条第１項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第３７編１条５６項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自身の知識に基ずいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基ずく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第１８編第１００１条に基ずき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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(日本語宣言書)

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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